



Methane and genetics in cattle : what role can genetics play in reducing emissions ?

Knowledge exchange webinar – 28/09/2026

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INRAE

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Introduction to Climate Farm Demo and Climate Smart Advisors

Knowledge exchange webinar – 10/12/2024

Climate Farm Demo in a nutshell

65

Partners

16 Academic and Universities

19 Advisory Services

16 Farmer Organisations

11 Applied Research Institutes

3 NGOs

27

Countries + **24** CAP Networks

1,500

Pilot Demonstration Farmers

4,500

On-farm demonstration events

250,000

Actors engaged in
peer-to-peer learning

10

Living Labs to co-create
new practical solutions

2030 Ambition

**IMPLEMENT,
DEMONSTRATE AND
UPTAKE Climate Smart
Farming (CSF) PRACTICES
ACROSS THE EU**



**REDUCE GHG EMISSIONS
significantly**

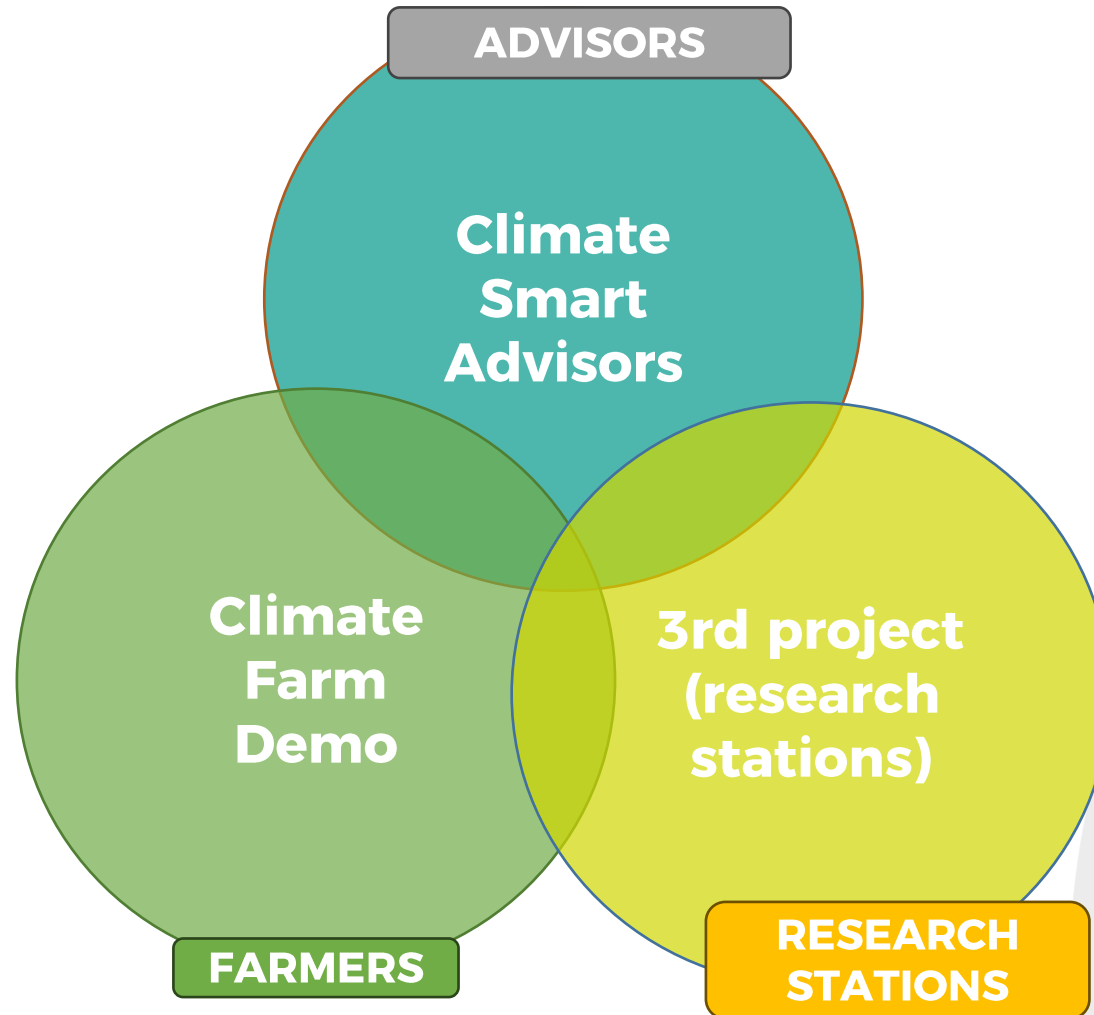


**ACHIEVE THE EU CLIMATE
TARGET PLAN**

Climate Smart Advisors in a nutshell



CSA implements approaches and solutions developed in CFD



CFD + CSA + project 3
= 1 Climate Smart Farming network

Connections at national level
(demonstrations, national meetings, ...) and at EU level
Joint conferences and knowledge exchange activities



12 thematic areas, each with a **Thematic Leader** to support knowledge exchange



Crops
management



Grassland
management



Forage
production



Agroforestry and
relation to landscape



Herd
management



Manure storage
and spreading



Soil health and
biodiversity



Additives for
reducing enteric
methane emissions



Energy
management



Biogas
production



Water
management



Rewarding
mechanisms

FYI, several webinars are available

- Measuring, predicting, reducing enteric methane emissions of dairy cows: easy or not? <https://www.youtube.com/watch?v=E-62yGC-ovw>
- Update on feed additives research in pasture based dairy systems in Ireland
<https://www.youtube.com/watch?v=FqrpYiPYNjA&t=1751s>
- Feed additives for methane reduction -Testimonials from dairy industries
<https://www.youtube.com/watch?v=oTS8XednMxM&t=47s>
- How to implement the right experiment to address feed additives efficiency on methane?
<https://www.youtube.com/watch?v=S40Aa8lp7qM&t=106s>
- Reducing methane from cattle | Insights from Canada
<https://www.youtube.com/watch?v=G4Ff969gb4s&t=2216s>

Today's speakers



Pauline MARTIN
Researcher at INRAE (Fr)
Cattle Genetics & Genomics
Focus on efficiency & health traits



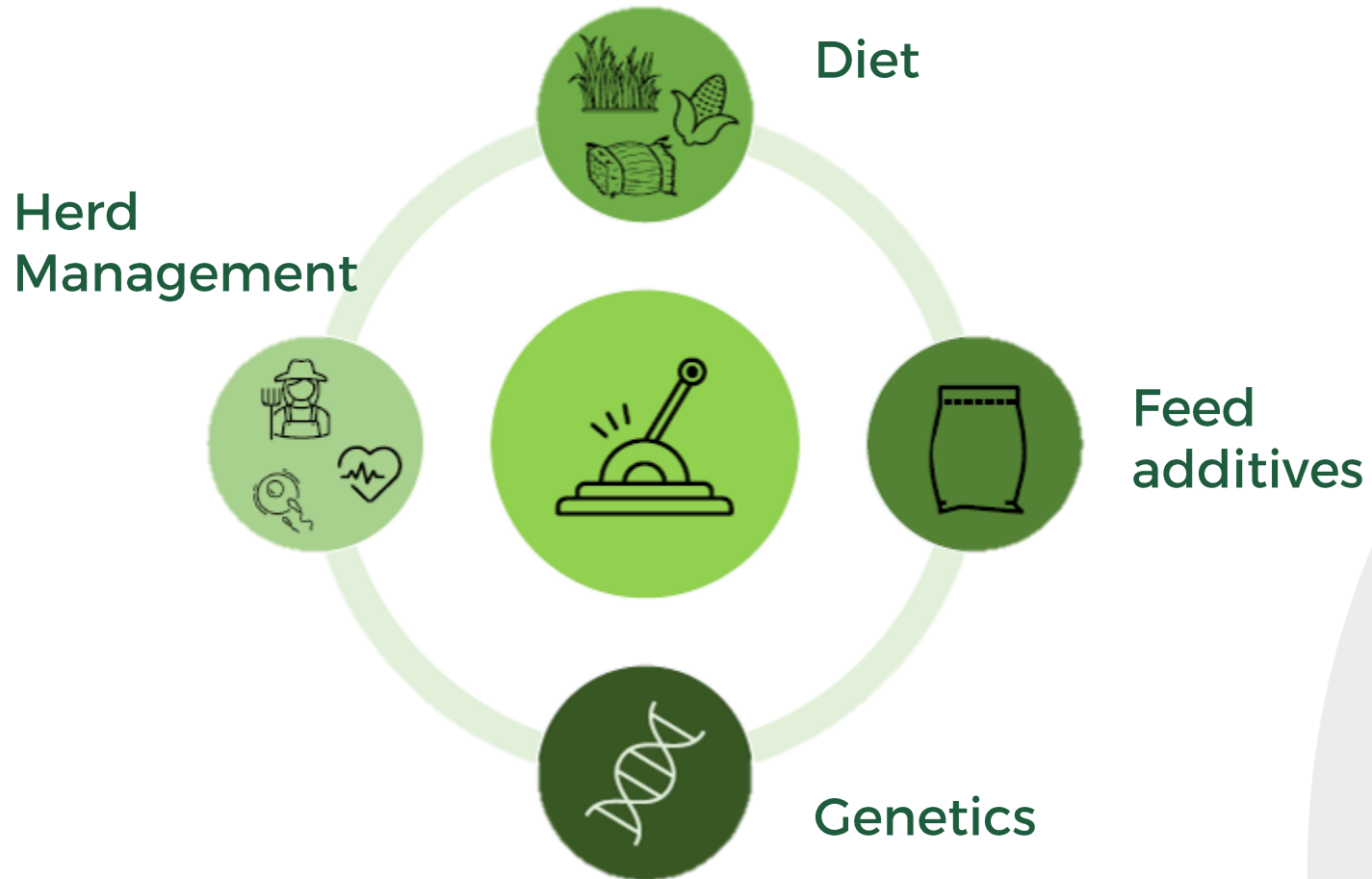
Manon GUILLERM
IDELE (Fr)
R&D projects in cattle genetics



Genetic selection for the reduction of methane emissions

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Genetic selection: a lever among others

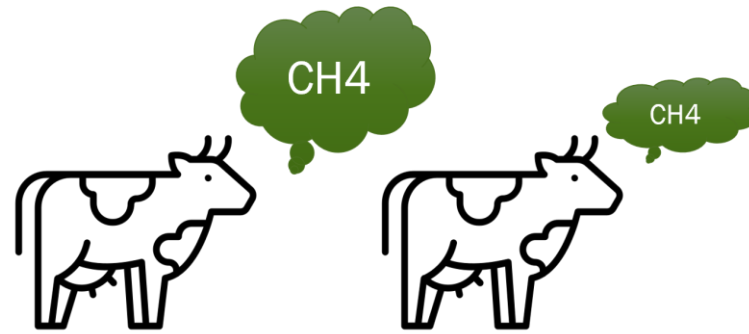


Pros and Cons:

- Takes time
- + Long lasting
Additive effect with time
- Cost ?

What is necessary to implement a genetic selection ?

Genetic selection = choose which animals to reproduce

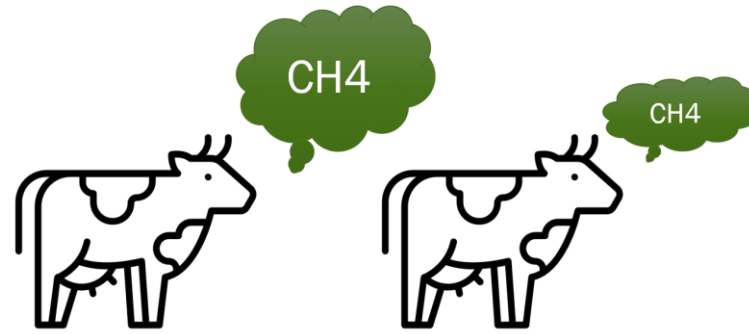


A need for:

- Variability among animals
- A bit of inheritance
- Looooots of phenotypes

What is necessary to implement a genetic selection ?

Genetic selection = choose which animals to reproduce



A need for:

- Variability among animals
- A bit of inheritance
- Looooots of phenotypes

➡ Cheap and easy to measure

Methane phenotyping for genetic purpose



Methane phenotyping for genetic purpose



Methane phenotyping for genetic purpose



Methane phenotyping for genetic purpose



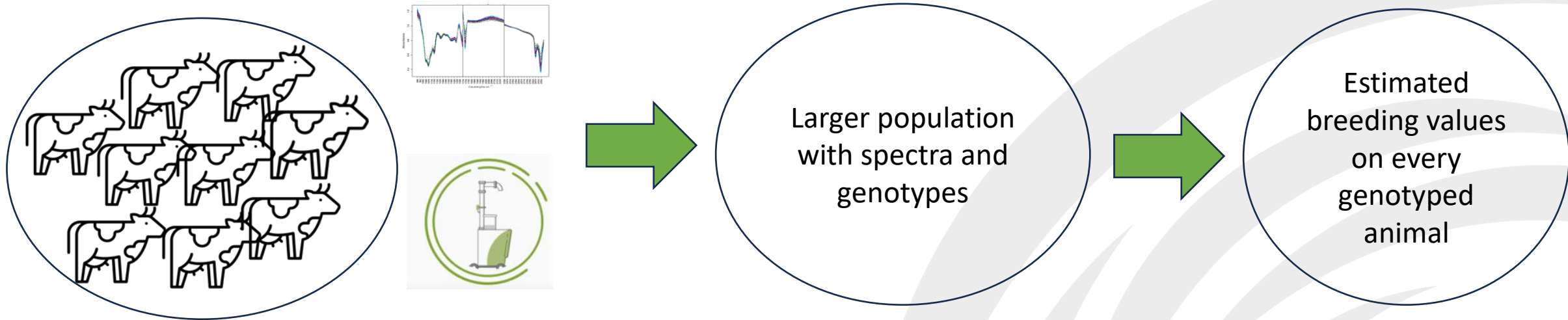
Methane phenotyping for genetic purpose



A proxy?

Predicting methane from milk MIR spectra

- Based on initial research of Dehareng et al., 2012



- MIR spectra used for fat and protein yield prediction
==> routinely available
- Always more equations, from different devices

Are methane emissions heritable?

- Heritability (h^2) = proportion of observed variability from genetic origin
- Abundant literature
- 5 to 35% when evaluated from direct measures (μ = 15-20%)
- Around 40% when MIR proxy predicted
- To compare with

h^2 fertility/health=<5%

h^2 milk=30%

h^2 milk
composition=40%



Are methane emissions genetically variable?

- Coefficient of variation (CV) = $\frac{\text{Genetic standard deviation}}{\text{Observed population mean}}$

- Genetic standard deviation around 60-70g/day

- Observed population mean around 500 g/day

➔ CV = 14%

- To compare with

CV fertility/health=13%

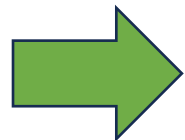
CV milk=7%

CV milk composition=5%

There is room for improvement!

Should we go for direct measures or MIR?

- MIR are here but they do not capture everything
- Possible confusion with milk traits
- Highly dependent on the prediction equation quality and its capacity to predict in other local contexts

 A good start but not optimal

Countries with published breeding values for methane emissions

Country	Breed(s)	Type of data
Spain	Holstein	Sniffer (n>6,000)
The Netherlands	Holstein	Sniffer & GF (n>12,000)
Denmark	Holstein, Red Danish, Jersey	Sniffer (n>17,000)
Ireland	Holstein, Jersey, X-breds	GF in field grazing
Belgium	Holstein	MIR prediction
Canada & Switzerland	Holstein, Jersey, Ayrshire, Brown Swiss	MIR prediction

Data collected through a GMG survey, in 2026
(kindly shared by Rob Banks and Birgit Gredler-Grandl)

International initiatives (sharing = better reliability)

GMG at a glance



Re-Livestock
RESILIENT FARMING SYSTEMS

>27M US\$ | 28 countries | 67 partners | 28 breeds | >100k animals

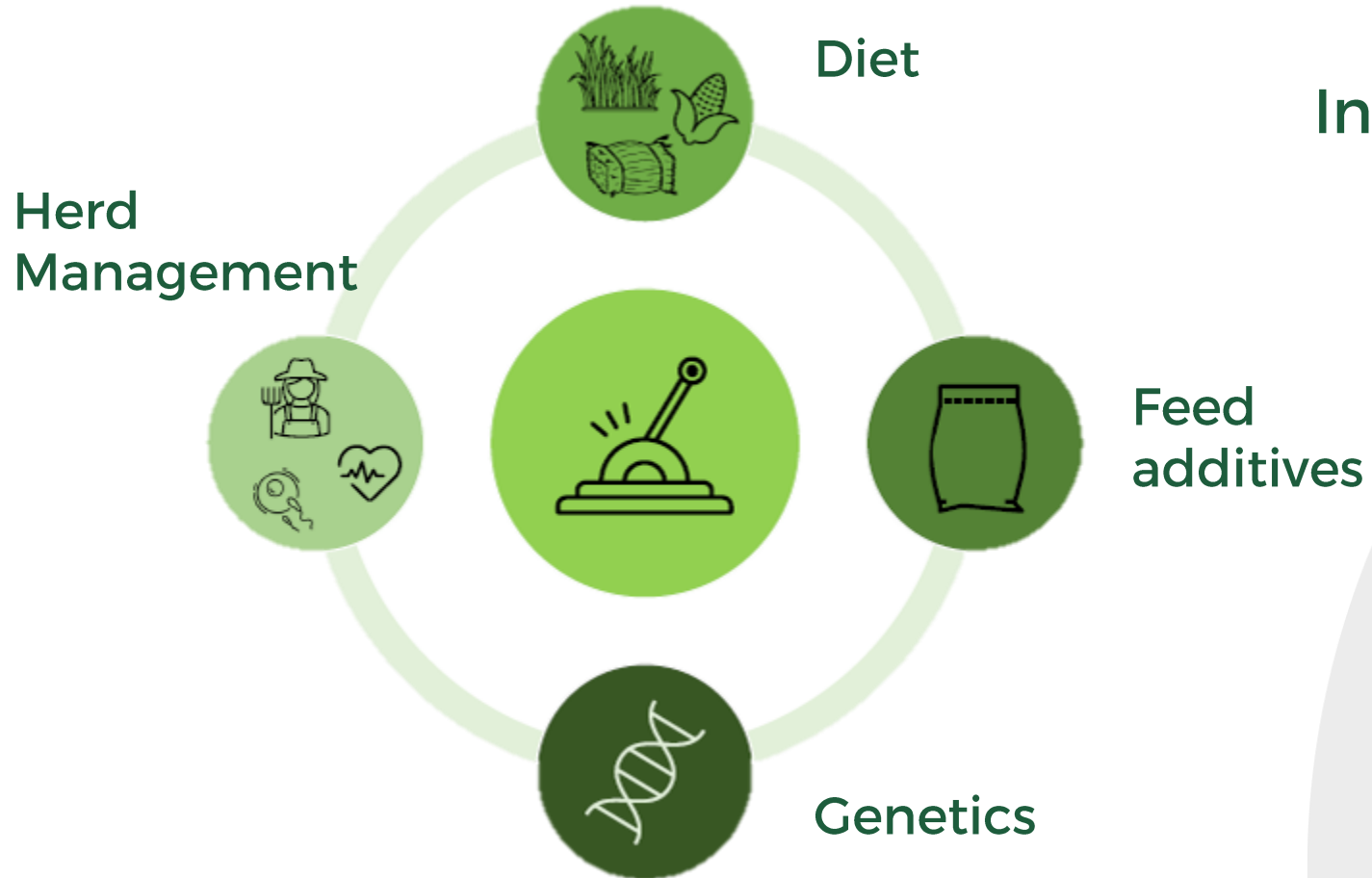
Accelerating genetic progress for lower methane emission
in ruminants

Core activities



DREAM Breeding

A lot more to investigate...



Interaction between levers?



Genetics and herd management

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Methane 2030 project

Develop multi-lever solutions to reduce enteric methane emissions in cattle farming

One of the aim : quantify methane emissions in different systems and evaluate the combination of action levers.

↳ *link between enteric methane emissions, genetics and herd management*

2 big questions :

What links can we identify between methane emission, farming practices and genetics ?

What common characteristics can be found among the lowest-emitting dairy farms ?

- **CAP'2ER database:**

- Methane emissions (/liters and /livestock unit)
- Farming system : geographical area, feeding system
- Herd management : age at first calving, culling & replacement rates, calving interval, milk production per cow

- **Genetic database (average per herd):**

- Performance recording
- Breeding values

- **3 biggest breeds : Normande, Montbeliarde, Prim'Holstein**

 Studied separately because of the breeding values

Methane emissions for the 3 breeds

Major breed (<i>>60% in the herd</i>)	Avg. Milk production (l/dc)	CH ₄ eq. CO ₂ /l	Avg. Livestock unit number	CH ₄ eq. CO ₂ /LU
Montbeliarde	6748	0,62 ± 0,08	105	3668,8 ± 322
Normand	6555	0,62 ± 0,07	138	3591,3 ± 267,5
Prim'Holstein	8153	0,55 ± 0,07	133	3853,1 ± 340,8

Correlation between units : - **0,43**

What links can we identify between methane emission, farming practices and genetics ?

How to read ?

« CH₄ emissions per livestock unit decrease with calving interval »
 « CH₄ emissions per litre increase with calving interval »

Calving interval
 Age at first calving
 Turnover rate
 Cull rate
 Proportion of maize in the main forage area
 Concentrate consumed
 MILK BV
 CRC BV
 DLO BV
 ISU

N = 699

Montbeliarde	CH4 ent / LU	-0,14	-0,39	0,11	0,16	0,46	0,21	0,32	0,04	0,06	0,23
	CH4 ent / l	0,19	0,4	-0,15	-0,17	-0,33	-0,12	-0,33	-0,09	-0,08	-0,28
Normande	CH4 ent / LU	-0,24	-0,39	0,26	0,16	0,44	0,39	0,18	0,11	0,07	0,07
	CH4 ent / l	0,19	0,26	-0,15	-0,12	-0,3	-0,18	-0,23	-0,13	-0,13	-0,16
Prim'holstein	CH4 ent / LU	-0,14	-0,34	0,15	0,08	0,33	0,22	0,23	0,16	0,09	0,18
	CH4 ent / l	0,19	0,45	-0,1	-0,05	-0,3	-0,03	-0,26	-0,23	-0,12	-0,24

N = 246

N = 1712

What links can we identify between methane emission, farming practices and genetics ?

How to read ?

« CH₄ emissions per livestock unit decrease with calving interval »
 « CH₄ emissions per litre increase with calving interval »

How to read ?

« CH₄ emissions per stock unit decrease with calving interval »

« CH₄ emissions per litre increase with calving interval »

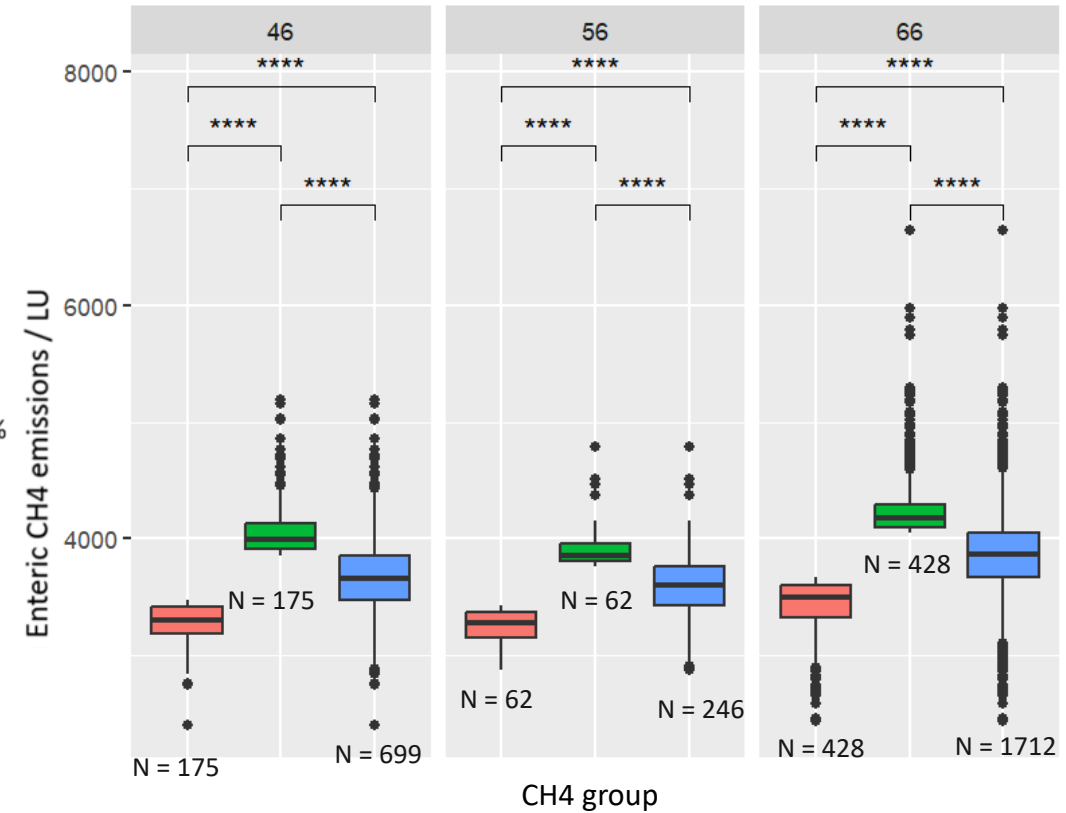
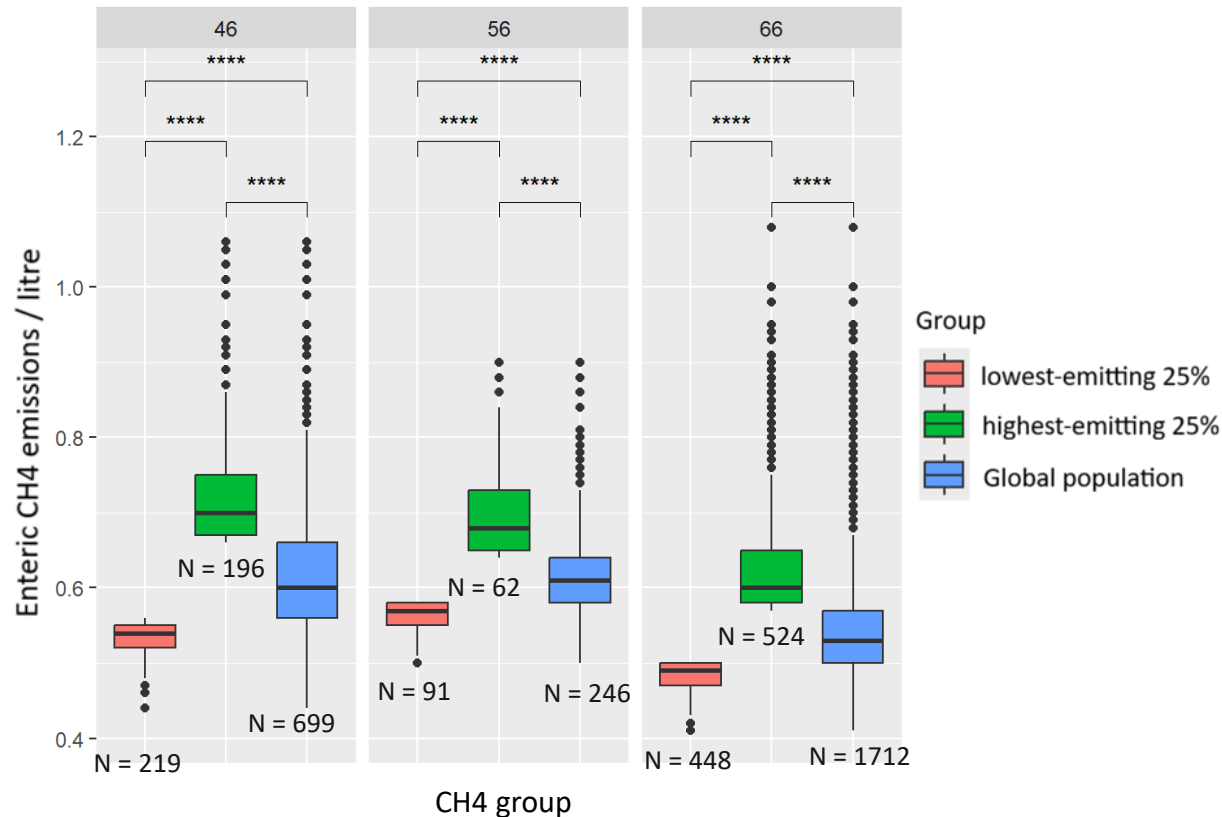
		Calving interval	Age at first calving	Turnover rate	Cull rate	Proportion of maize in the main forage area	Concentrate consumed	MILK BV	CRC BV	DLO BV	ISU
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Higher correlation between CH₄ emissions and :

- Age at first calving
- Proportion of maize in the MFA
- MILK breeding value

Inverse correlations between 2 units

What common characteristics can be found among the lowest-emitting dairy farms ?



2 groups created : the lowest-emitting 25%, and the highest 25%

→ **FOCUS on the lowest-emitting 25%**



What common characteristics can be found among the lowest-emitting dairy farms ?

Method

T.Test to measure differences between the average of the lowest-emitting group and the global population → **significance of the differences**

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T.Test to measure differences between the average of the lowest-emitting group and the global population → **significance of the differences**

Montbeliarde breed	
CH ₄ eq. CO ₂ /L	CH ₄ eq. CO ₂ /LU
 High part of maize in the MFA and concentrate consumed	 Less maize in the MFA and concentrate consumed
 Low age at first calving	 High calving interval and age at first calving
 High turnover and cull rates	 Low turnover and cull rates
 Better CRC and MILK breeding values	 Lower CRC and MILK breeding values

Only significant differences

What common characteristics can be found among the lowest-emitting dairy farms ?

Normande breed	
CH ₄ eq. CO ₂ /L	CH ₄ eq. CO ₂ /LU
 High part of maize in the MFA and concentrate consumed  Low age at first calving  Better DLO and MILK breeding values	 Less maize in the MFA and concentrate consumed  High calving interval and age at first calving Low turnover and cull rates  Lower CRC and MILK breeding values

Only significant differences

What common characteristics can be found among the lowest-emitting dairy farms ?

Normande breed	
CH ₄ eq. CO ₂ /L	CH ₄ eq. CO ₂ /LU
 High part of maize in the MFA and concentrate consumed  Low age at first calving  Better DLO and MILK breeding values	 Less maize in the MFA and concentrate consumed  High calving interval and age at first calving Low turnover and cull rates  Lower CRC and MILK breeding values
Prim'holstein breed	
CH ₄ eq. CO ₂ /L	CH ₄ eq. CO ₂ /LU
 High part of maize in the MFA and concentrate consumed  Low age at first calving and calving interval High cull rate  Better CRC and MILK breeding values	 Less maize in the MFA and concentrate consumed  High calving interval and age at first calving Low turnover and cull rates  Lower CRC, DLO and MILK breeding values

Only significant differences

What common characteristics can be found among the lowest-emitting dairy farms ?

Is there herds considered as lowest-emitting with both units ?

1% of the herds in this situation :

→ 23 Prim'holstein, 4 Montbeliarde, 2 Normande

Characteristics for Prim'holstein herds :

- Lower age at first calving (27,2 vs 27,8 months)
- Higher turnover and cull rates (37% vs 34% and 27% vs 25%)
- More concentrate consumed (245 vs 211 g/l/dc)
- Higher MILK, CRC, DLO and ISU breeding values

What common characteristics can be found among the lowest-emitting dairy farms ?

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Not enough herds to conclude in Normande and Montbéliarde

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Conclusion

Study that highlights trends → need to be confirmed by further analysis

Lowest-emitting on both units : good reproductive management and better MILK and CRC breeding values



Looking ahead

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What are the prospects for genetics as a lever to reduce methane emissions?

- Integrate methane emissions reductions from selection on other traits
 - Animal level (i.e. reduction of body size)
 - Herd level : reducing mortality, age at first calving, increasing fertility, longevity...
- Think at different scales (animal to herd to national)

What are the prospects for genetics as a lever to reduce methane emissions?

- Possible to select but no active selection yet...
- No economic value (except in Denmark)
- Selecting for methane = reduced genetic gain for other traits
= loss of competitiveness
- Need to be ready when real pressure will be applied...

What questions remain, particularly regarding how methane emissions should be expressed?

Different results regarding the unit except for 1% of the herds

high milk production → low CH₄ emissions / liters
→ high CH₄ emissions/ livestock unit

Methane emission / livestock unit :

CH₄ emissions only for dairy activity (without heifers)
Livestock unit (with heifers)

What questions remain, particularly regarding how methane emissions should be expressed?

Other units to study :

- CH₄ emissions / hectares of UAA
 - needs to be done for similar agricultural systems
- CH₄ emissions for the whole dairy activity
 - comparison for similar sizes of herds

Take home message

The genetic lever has quite a large potential but to pull it or not is a political choice

Many units for expressing methane emissions, with different results...the choice depends on the question



Thank you!



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